



2014 EXECUTIVE SUMMARY

Missouri Airport Pavement Management System



Overview

BACKGROUND

Pavements represent one of the largest capital investments in the Missouri aviation system, and the condition of these pavements is important both from cost-effectiveness and safety standpoints. It is crucial to apply pavement maintenance and rehabilitation (M&R) in a timely manner, since repairs typically become more costly as conditions deteriorate. Additionally, airport pavement weaknesses, such as cracks and loose debris, can pose a safety risk to aircraft.

Recognizing a need to protect this critical investment, the Missouri Department of Transportation (MoDOT), Multimodal Operations Division – Aviation Section established a statewide airport pavement management system (APMS) in 2002 to monitor the condition of the Missouri airport infrastructure and to proactively plan for its preservation. Since that time, the APMS has been periodically updated. The ultimate goal of this endeavor is to provide the airports, MoDOT, and the Federal Aviation Administration (FAA) with the pavement information and analytical tools that can help them identify pavement-related needs, optimize the selection of projects and treatments over a multi-year period, and evaluate the long-term impacts of project priorities.

This Executive Summary describes the findings and recommendations of the latest APMS project, which included assessing pavement conditions (some in 2011 and some in 2014) at seventy Missouri airports. The data were analyzed to determine the overall health of the aviation pavement system, to identify pavement-related needs, and to provide recommendations for pavement M&R.

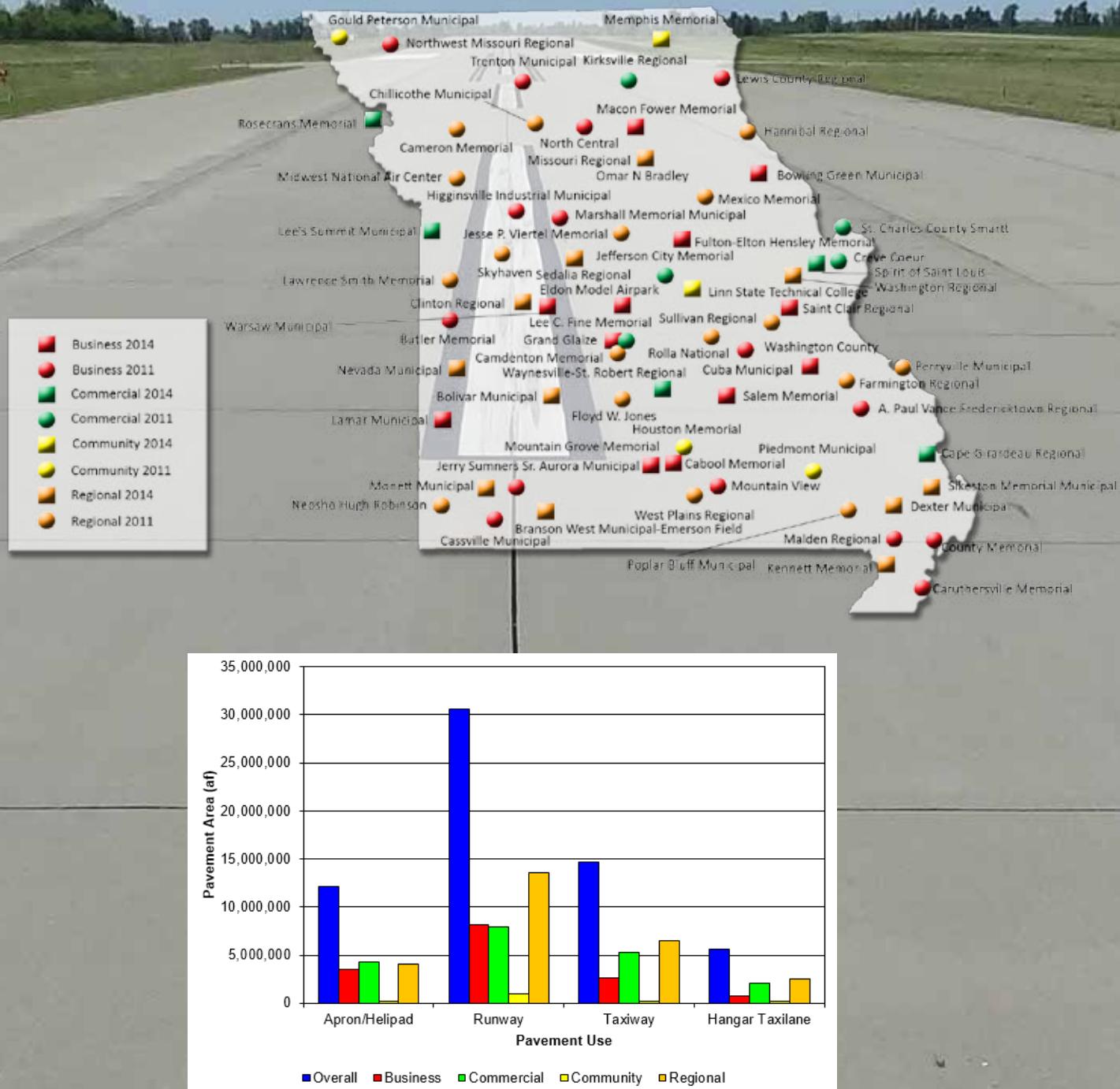
BENEFITS OF THE APMS

The MoDOT APMS yields many benefits. It provides MoDOT, the individual airports, and the FAA with the information needed to monitor the condition of the pavements to ensure they are able to safely accommodate aircraft operations. The APMS also provides MoDOT with information necessary to make cost-effective decisions about the M&R of the pavement infrastructure while understanding the long-term impacts of the decisions made. In addition, the APMS fulfills many of the National Plan of Integrated Airport Systems (NPIAS) airport requirements of Public Law 103-305 and Grant Assurance 11 for maintaining a pavement maintenance management system.

The APMS also identifies when different pavement strategies would be most appropriate. The timing of projects is important because preventive maintenance actions, such as crack sealing and surface treatments, can cost-effectively extend the life of a pavement. Once preventive maintenance is no longer the appropriate repair, it is critical to step in with major rehabilitation, such as an overlay or surface reconstruction, as soon as possible. At some point, the pavement structure may become so degraded that the only viable alternative is complete reconstruction. The financial impact of delaying repairs until this point is reached can be severe, as the cost of reconstruction can be many times that of an overlay. In addition, there is a point where the pavement becomes unsafe for aircraft operations.

Project Airports

In 2011 and 2014, pavement work history information was updated in MoDOT's PAVER™ database for the seventy NPIAS airports shown below. These airports represent 63.1 million square feet of pavement—enough airport pavement to pave a two-lane highway from Kansas City to St. Louis and back. This can be further broken down into 30.6 million square feet of runway pavement, 14.7 million square feet of taxiway pavement, 12.1 million square feet of apron/helipad pavement, and 5.6 million square feet of hangar taxilane pavement. The figure shows the distribution of pavement area by pavement use and airport classification as defined in the 2005 Missouri State Airport System Plan.



Pavement Condition Assessment

PAVEMENT CONDITION INDEX

The pavements were evaluated using the Pavement Condition Index (PCI) procedure, documented in FAA Advisory Circular (AC) 150/5380-6B, *Guidelines and Procedures for Maintenance of Airport Pavements*, and ASTM D5340, *Standard Test Method for Airport Pavement Condition Index Surveys*. During a PCI survey, the types, severities, and amounts of distress present on a pavement surface are quantified. This information is then used to develop a composite index that represents the overall condition of the pavement in numerical terms, ranging from 0 (failed) to 100 (excellent). The PCI is a measure of overall condition and is indicative of the level of work that will be required to maintain or repair a pavement. Further, the distress information provides insight into what is causing the pavement to deteriorate, which is the first step in selecting the appropriate repair action.

Programmed into an APMS, PCI data are used to determine current pavement condition, predict future pavement condition, and identify the most cost-effective repair type and timing of that repair. The relationship between a pavement's PCI and the typical type of repair recommended for the pavement is shown in the figure below.

PCI	Representative Pavement Surface	Repair Alternative
88		Pavements with PCIs above 65 often benefit from cost-effective preventive maintenance, such as crack sealing and surface treatments.
60		Pavements with a PCI in the range of 40 to 65 will typically require more expensive rehabilitation, such as an overlay.
29		Pavement allowed to deteriorate below a PCI of 40 could require costly reconstruction to restore it to operational condition.

Pavement Condition Assessment

TYPICAL DISTRESS TYPES AT MISSOURI AIRPORTS

The following describes the pavement distresses frequently observed at the evaluated Missouri airports. The first four distress types listed occur on asphalt-surfaced pavements, while joint seal damage and longitudinal, transverse, and diagonal (LTD) cracking occur on portland cement concrete (PCC) pavements.



ALLIGATOR CRACKING

Alligator cracking is a load-related distress caused by excessive tensile strains at the bottom of the asphalt (AC) layer or stabilized asphalt base layer from repeated aircraft loadings. It typically shows up on the surface as a series of parallel cracks, which eventually interconnect to form a pattern resembling alligator skin.



LONGITUDINAL AND TRANSVERSE (L&T) CRACKING

L&T cracking can be caused by any of the following: 1) separation of pavement at paving lane joints, 2) shrinkage of AC pavement due to temperature differentials in older or brittle pavements, or 3) reflection cracking from underlying existing cracking in overlaid pavements.



RAVELING

Raveling occurs as the coarse aggregate begins to dislodge and produce loose pieces of material, posing a safety hazard as it may be ingested by aircraft engines.



WEATHERING

Weathering is the wearing away of the asphalt binder and/or fine aggregate that occurs as the asphalt pavement ages and hardens.



JOINT SEAL DAMAGE

Joint seal damage is any condition that allows water or incompressibles to enter the joint, including hardening or oxidation of the filler, loss of bond of the joint sealant to the slab edges, weed growth, extrusion of the joint sealant, stripping of the joint sealant, or absence of sealant in the joint.



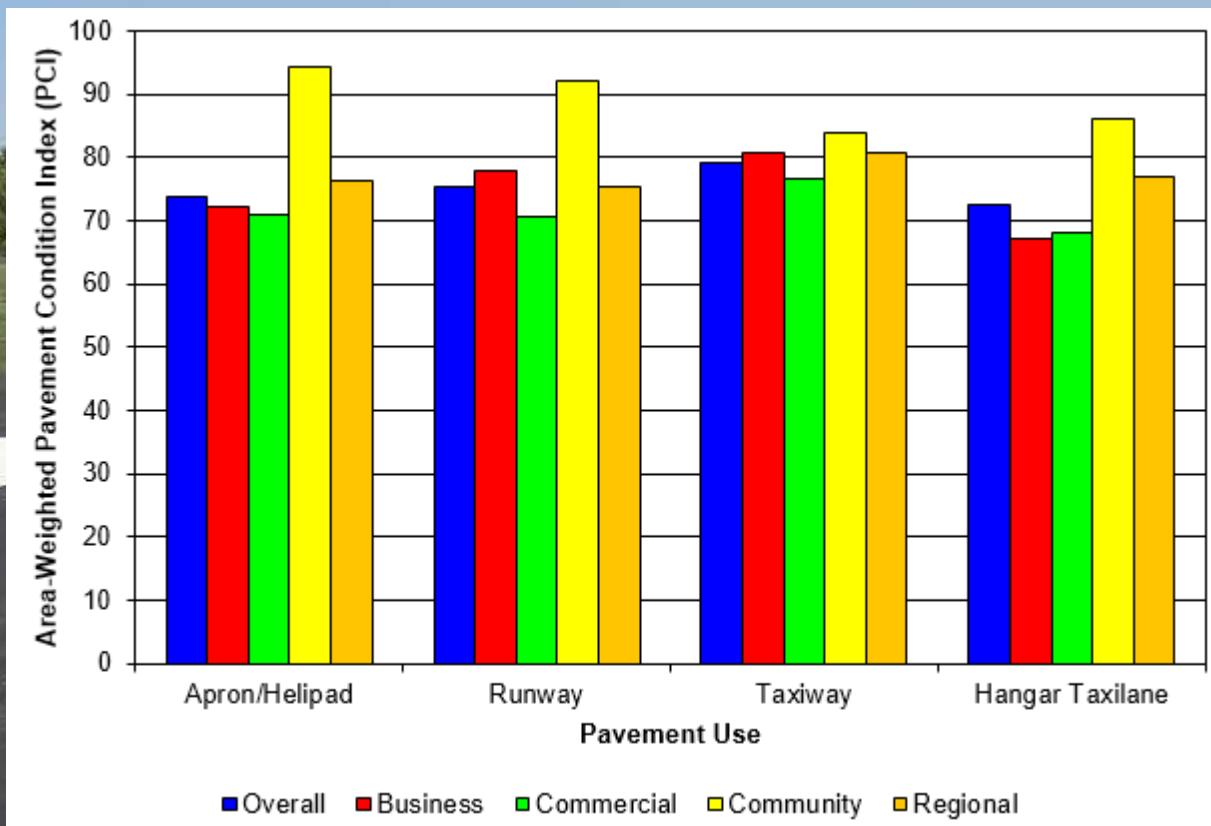
LONGITUDINAL, TRANSVERSE, AND DIAGONAL (LTD) CRACKING

LTD cracking is usually caused by a combination of load repetition, curling stresses, and/or shrinkage stresses.

Pavement Condition Results

OVERALL PAVEMENT CONDITION

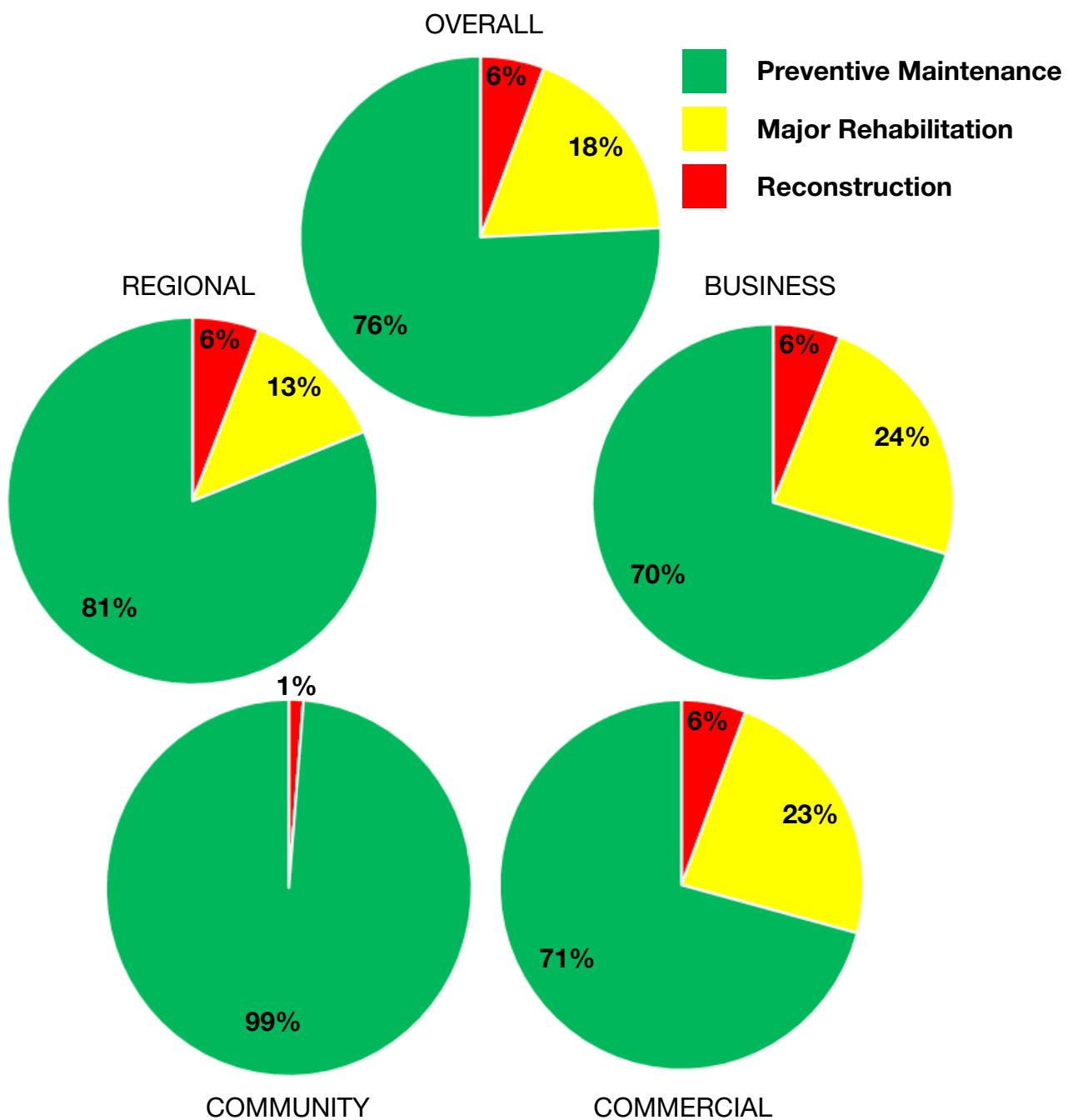
The area-weighted PCI (average PCI adjusted to account for the relative size of the pavement sections) at the time of last inspection of the seventy airports is 76. The figure below shows the area-weighted condition of the pavement, also at the time of last inspection, broken out by airport classification.



Pavement Condition Results

PAVEMENT CONDITION DISTRIBUTION

The following figures show, in general, the level of work that is needed based on the pavement condition at the time of last inspection (either 2011 or 2014). Approximately 76 percent of the pavement is at the condition level where it will benefit from preventive maintenance actions, such as crack sealing, joint sealing, patching, and surface treatments. Approximately 18 percent of the pavement is in need of more extensive rehabilitation, while approximately 6 percent is to a point where reconstruction may be the only viable alternative to restoring the pavement.



Needs Assessment

An M&R program was developed for the MoDOT airports using the PAVER™ pavement management software. The analysis was prepared for 5 years (2015 to 2019). An inflation rate of 3 percent was applied when calculating the future cost of work. Preventive maintenance, global maintenance (or surface treatments), and major rehabilitation were considered during this analysis.

CRITICAL PCIS

For each year of the analysis, the future conditions of the pavements were estimated, and a determination was made as to whether preventive maintenance or major rehabilitation/reconstruction was the appropriate and most cost-effective strategy. A pavement was triggered for preventive maintenance if it was above a critical PCI of 65 for runways and 60 for taxiways, aprons, helipads, and hangar taxilanes. Below these critical PCI thresholds, major rehabilitation/reconstruction was recommended.

FUNDING LEVELS

If no funding is provided for pavement M&R, condition will steadily decline at Missouri airports; it is forecasted that the PCI of the seventy airports would drop to a PCI of 67 by the end of 2019. This decrease would result in a greater need for major rehabilitation/reconstruction, which in turn would substantially increase the costs to keep the pavement system in a safe and serviceable condition.

At the other end of the scale, if all M&R projects identified were funded, the resulting PCI of the seventy airports would be 86 by the end of 2019. This would require approximately \$173.6 million in funding over the next 5 years: \$42.2 million for business airports, \$69.0 million for commercial service airports, \$0.3 million for community airports, and \$62.1 million for regional airports. The funding needs through 2019 for each airport under an unlimited budget are summarized in the table on the next page.

Unlimited Funding Needs Through 2019

State System Plan Classification	Airport Name	Inspection Year	Area-Weighted PCI	Estimated Funding Needs
Business	A. Paul Vance Fredericktown Regional	2011	68	\$2,595,144
	Bowling Green Municipal	2014	82	\$3,872
	Butler Memorial	2011	88	\$45,955
	Cabool Memorial	2014	63	\$1,301,253
	Caruthersville Memorial	2011	94	\$169
	Cassville Municipal	2011	66	\$1,305,185
	County Memorial (New Madrid County)	2011	87	\$213,360
	Cuba Municipal	2011	58	\$1,972,010
	Eldon Model Airpark	2014	94	\$276,442
	Fulton-Elton Hensley Memorial	2014	78	\$1,593,151
	Grand Glaize	2014	60	\$2,256,246
	Higginsville Industrial Municipal	2011	81	\$1,054,853
	Jerry Sumners Sr. Aurora Municipal	2011	78	\$567,904
	Lamar Municipal	2014	85	\$1,394,317
	Lewis County Regional	2011	88	\$93,161
	Macon Fower Memorial	2014	93	\$300,394
	Malden Regional	2011	67	\$13,403,111
	Marshall Memorial Municipal	2011	93	\$2,225
	Mountain Grove Memorial	2014	83	\$177,897
	Mountain View	2011	62	\$3,703,930
	North Central Missouri Regional (Brookfield/Marceline)	2011	89	\$212,667
	Northwest Missouri Regional (Maryville)	2011	72	\$2,678,023
	Saint Clair Regional	2014	58	\$2,196,291
	Salem Memorial	2014	62	\$1,187,968
	Trenton Municipal	2011	66	\$2,307,638
	Warsaw Municipal	2014	97	\$26,615
	Washington County	2014	67	\$1,336,013
Commercial Service	Cape Girardeau Regional	2014	76	\$5,540,234
	Creve Coeur	2011	87	\$696,080
	Jefferson City Memorial	2011	76	\$6,037,002
	Kirksville Regional	2011	68	\$6,196,811
	Lee C. Fine Memorial (Kaiser)	2011	59	\$10,589,714
	Lee's Summit Municipal	2014	73	\$6,297,133
	Rosecrans Memorial (St. Joseph)	2014	68	\$15,850,404
	Spirit Of St. Louis	2014	70	\$13,240,133
	St. Charles County Smartt	2011	75	\$4,555,640
	Waynesville-St. Robert Regional	2014	94	\$14,514

Unlimited Funding Needs Through 2019

State System Plan Classification	Airport Name	Inspection year	Area-Weighted PCI	Estimated Funding Needs
Community	Gould Peterson Municipal (Tarkio)	2011	91	\$34,127
	Houston Memorial	2011	97	\$6,724
	Linn State Technical College	2014	90	\$33,233
	Memphis Memorial	2014	69	\$231,016
	Piedmont Municipal	2011	99	\$10
Regional	Bolivar Municipal	2014	74	\$925,861
	Branson West Municipal - Emerson Field	2014	98	\$55
	Camdenton Memorial	2011	75	\$1,402,912
	Cameron Memorial	2011	84	\$773,396
	Chillicothe Municipal	2011	59	\$3,907,523
	Clinton Regional	2014	67	\$4,337,969
	Dexter Municipal	2014	77	\$1,986,702
	Farmington Regional	2011	93	\$194,936
	Floyd W. Jones (Lebanon)	2011	71	\$2,982,418
	Hannibal Regional	2011	91	\$262,255
	Jesse P. Viertel Memorial (Boonville)	2011	86	\$402,958
	Kennett Memorial	2014	84	\$1,436,128
	Lawrence Smith Memorial (Harrisonville)	2011	53	\$3,874,022
	Mexico Memorial	2011	88	\$1,000,486
	Midwest National Air Center (Clay County)	2011	72	\$5,200,737
	Monett Municipal	2014	81	\$274,273
	Neosho Hugh Robinson	2011	72	\$3,482,025
	Nevada Municipal	2014	82	\$1,111,350
	Omar N. Bradley (Moberly)	2014	64	\$4,181,389
	Perryville Municipal	2011	82	\$696,298
	Poplar Bluff Municipal	2011	73	\$3,451,890
	Rolla National	2011	68	\$8,219,757
	Sedalia Regional	2014	78	\$4,000,937
	Sikeston Memorial Municipal	2014	77	\$1,004,220
	Skyhaven	2011	76	\$3,733,326
	Sullivan Regional	2011	81	\$725,682
	Washington Regional	2014	80	\$438,113
	West Plains Regional	2011	80	\$2,042,678
Estimated Statewide Total:				\$173,578,867

IN SUMMARY

- Seventy NPIAS airports were included in the Missouri APMS.
- The seventy airports have 63.1 million square feet of pavement—enough airport pavement to pave a two-lane highway from Kansas City to St. Louis and back. This can be further broken down into 30.6 million square feet of runway pavement, 14.7 million square feet of taxiway pavement, 12.1 million square feet of apron/helipad pavement, and 5.6 million square feet of hangar taxilane pavement.
- The pavement system has an area-weighted PCI of 76 based on the condition at the time of last inspection. Approximately 76 percent of the pavement area is at a condition level where preventive maintenance, such as crack sealing, is a cost-effective approach to maintaining the pavement. However, 24 percent of the pavement area has deteriorated to the condition where major rehabilitation or even reconstruction is needed.
- If no funding for pavement M&R is provided, the overall area-weighted PCI of the system will deteriorate to an estimated 67 by 2019.
- If all the projects identified as needing pavement M&R at the seventy NPIAS airports included in the project scope are funded over the next 5 years, approximately \$173.6 million will be needed.



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